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VERIFICATION STUDY FOR ASSESSMENT OF POTENTIAL GROUNDWATER POLLUTION
NAS WHITING FIELD FL
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GERAGHTY & MILLER, INC.

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VERIFICATION STUDY
ASSESSMENT OF POTENTIAL
GROUND-WATER POLLUTION
AT NAVAL AIR STATION
WHITING FIELD, FLORIDA

Prepared for
NAVAL FACILITIES ENGINEERING COMMAND
Southern Division
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INTRODUCTION

In April 1986, Geraghty & Miller, Inc., (G&M) was retained by the Naval Facilities Engineering Command, Southern Division (Navy) to provide hydrogeologic consulting services at the Whiting Field Naval Air Station (NAS) near Milton, Florida (see Figure 1). Specifically, G&M was to assist the Navy in performing Phase II (Confirmation Study) of the Navy Assessment and Control of Installation Pollutants (NACIP) program. This program is designed to identify contamination of Navy lands resulting from past waste-management activities and to institute corrective measures as needed.

The NACIP program consists of three phases. The first phase is the Initial Assessment Study (IAS) which utilizes record searches and personnel interviews to collect and evaluate all evidence supporting the existence of a contamination problem at an installation. This phase was completed in May 1985 and resulted in the preparation of a report entitled Initial Assessment Study of Naval Air Station Whiting Field, Milton, Florida.

The second phase, the Confirmation Study, involves on-site investigations to confirm or refute the existence of contamination and to quantify the extent of the problem if contamination is present and to evaluate the necessity of conducting mitigating actions or clean-up operations.

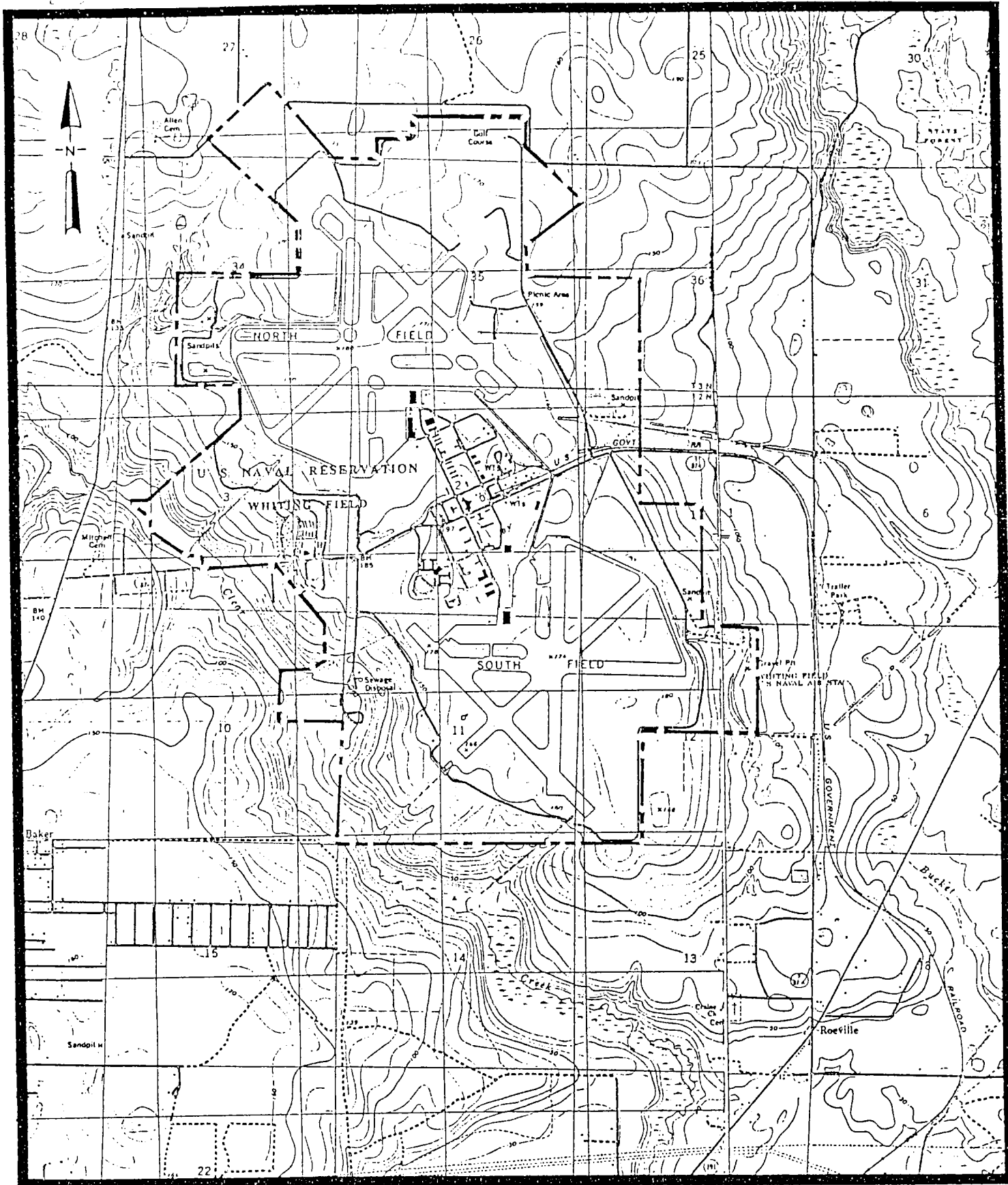


FIGURE 1. Location and Property Boundaries of NAS Whiting Field, Florida.

The third and final phase is the implementation of corrective actions and remedial measures to control or mitigate the contamination.

The Confirmation Study consists of two parts, Verification and Characterization. During Verification, the presence or absence of potential contaminants in ground water at each of the sites recommended for study in the IAS is assessed. Based on these findings, further investigation is recommended for Characterization in order to determine the nature and extent of contamination at sites requiring additional study.

During the Verification Study, 17 sites were studied and their locations are shown in Figure 2; the site identification numbering system used in the IAS report has been retained and extended to this study. This report presents the work performed and results of the Verification Study and contains recommendations for further characterization at selected sites.

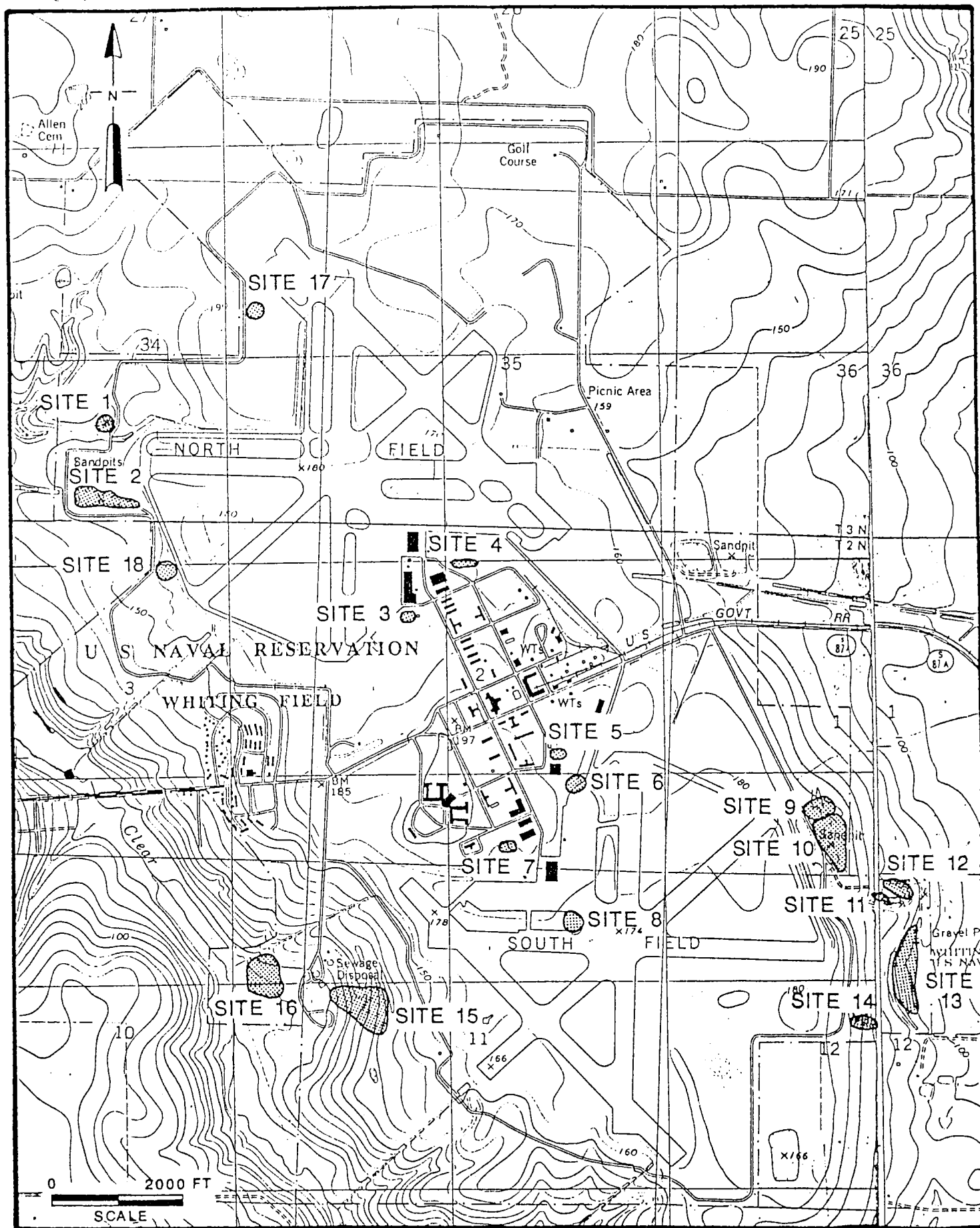


FIGURE 2. Locations of Sites Investigated at NAS Whiting Field.

APPROACH

The objective of the Verification Study is to determine whether release of hazardous pollutants into the soil, ground water, or surface water has occurred from past hazardous-waste disposal methods. In evaluating the sites during the Confirmation Study, the primary consideration is the risk to human health and the environment. The factors taken into account in preparing recommendations for further study at specific sites, as outlined in Florida Administrative Code 17-4.245(7)b, include: (1) size of the contaminant plume, (2) toxicity of the contaminants and their concentrations, (3) rate and direction of plume movement in relation to sources of water supply, (4) rate of attenuation of the plume, (5) current and projected future use of adjacent ground and surface waters affected by the plume, and (6) costs of further study or clean-up in comparison to the benefits to the public of such actions.

For sites where characterization studies are recommended, the proposed programs of monitor-well installation and sampling are designed to provide sufficient data for determining the need for long-term monitoring or corrective action and for the design of corrective measures, if necessary. For other sites, although low levels of contaminants may have been found, no further actions were recommended because of the limited benefits to the public in view of the costs for additional study or clean-up.

BACKGROUND

Since its commission in 1943, NAS Whiting Field has generated a variety of wastes related to pilot training, the operation and maintenance of aircraft along with ground support equipment, and the station's facility maintenance activities. Both liquid and solid wastes from these sources have been disposed of at various places on the base. Most of the operations and activities at the station are now provided by private contractors; therefore, very few people are available that can provide detailed information on disposal practices prior to the past five years.

The IAS identified 16 waste-disposal sites at NAS Whiting Field and, based on this study, 15 sites were recommended for further evaluation; Site 2 (Northwest Open Disposal Area) was judged to not warrant further consideration. In November 1985, G&M prepared for the Navy a Plan of Action entitled Naval Assessment and Control of Installation Pollutants, Verification Study, NAS Whiting Field, which was subsequently submitted to the Florida Department of Environmental Regulation (FDER). After discussions with the FDER during a meeting on December 17, 1985, some changes to the Plan of Action were made and two more sites (17 and 18) were added to the Confirmation Study. Both sites are active sites where waste oils and fuels are burned in firefighting-training exercises. One of the sites (Site 5 Battery Shop Seepage Pit) is presently being studied

under Consent Order with the FDER and data from the site are included in a separate report entitled Detection and Monitoring Program, Battery Shop Site, NAS Whiting Field, Florida, dated November 14, 1985. Baseline data collected from Site 5 have been used to assist in the overall understanding of the ground-water system at the base.

WORK PERFORMED

Work conducted during the course of this study began with the collection and assimilation of existing data and literature pertinent to the project which included the IAS. A Plan of Action was then prepared (December 1985), which contained details of the proposed scope of work for the Verification Study. In addition, a Quality Assurance Project Plan was prepared and submitted to the FDER for their review and approval. The field work was performed in May and June 1986 and included the items described below.

Monitor Wells

Sixteen monitor wells were installed at the locations described in the individual site assessments. All wells were installed and screened into the uppermost saturated part of the sand and gravel aquifer. The construction details of a typical monitor well are shown schematically in Figure 3 and construction details for each monitor well are presented in Table 1. All wells were drilled by the mud-rotary method and drill cutting samples were collected at 5-foot intervals and described by a geologist; lithologic logs of each well location are contained in Appendix A. The casing and screen consisted of Schedule 40 threaded PVC so that no PVC cement was used; four-inch-diameter casing and screen were necessary in order to install a submersible pump for development and sampling. All well screens were 10-feet long with 0.010-inch slots. A gravel pack of 20/30 grade silica sand was tremmied

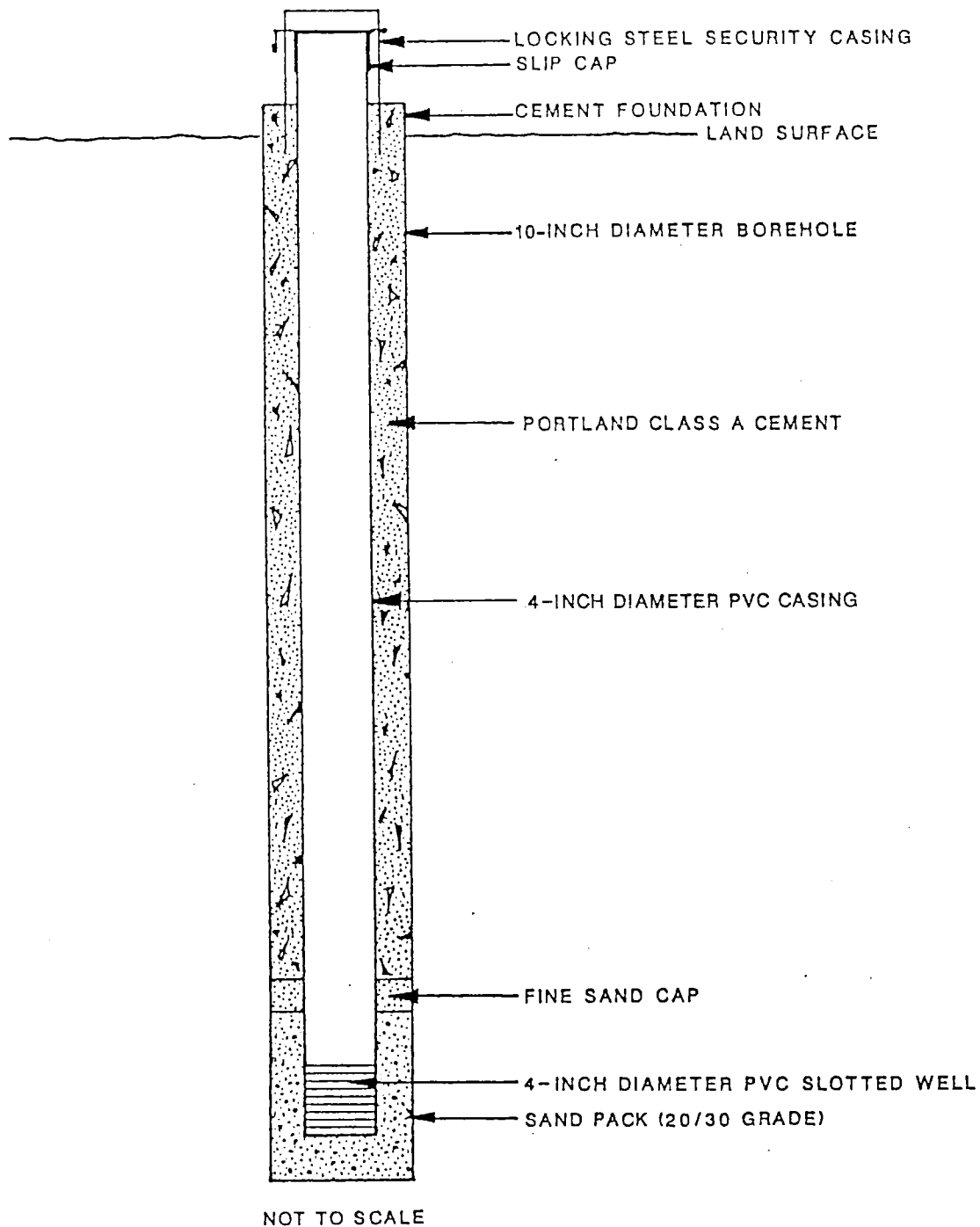


FIGURE 3. Schematic Diagram of Monitor Well Showing Typical Construction Details.

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Table 1. Construction Details of Monitor Wells
Installed by Geraghty & Miller, Inc.,
at NAS Whiting Field

SITE/ WELL NUMBER	LAND ELEVATION (ft msl)	TOP OF CASING (ft msl)	TOTAL WELL DEPTH (ft)	SCREEN INTERVAL (ft)	DEPTH TO GRAVEL PACK (ft)
1	140.55	142.60	122.5	112.5-122.5	104
3E	173.52	175.42	152.5	142.5-152.5	134
3W	173.51	174.90	152.5	142.5-152.5	134
4	170.62	172.49	152.5	142.5-152.5	134
7	185.02	187.77	142.5	132.5-142.5	124
8	172.36	172.92	180.0	170.0-180.0	162
9	145.06	146.60	117.5	107.5-117.5	100
10	144.51	146.77	117.5	107.5-117.5	100
11	115.19	116.70	127.5	117.5-127.5	110
12	134.53	136.49	112.5	102.5-112.5	93
13	100.68	102.69	112.5	102.5-112.5	104
14	137.88	139.73	152.5	142.5-152.5	134
15	64.28	66.21	72.5	62.5- 72.5	54
16	46.89	49.89	42.5	32.5- 42.5	26
17	192.63	194.66	152.5	142.5-152.5	132
18	161.33	163.49	122.5	112.5-122.5	104

(ft msl) = feet above mean sea level datum

into the annular space between well casing/screen and the borehole to approximately 3 to 4 feet (ft) above the screened interval and then capped with one foot of fine-grained sand. Portland Class A cement was then tremmied in the annular space up to the surface and an 8-inch-diameter locking steel security casing was installed with an 18-inch-diameter apron at its base. Development consisted of airlifting and then by pumping with a submersible pump. Each well was developed approximately four hours or until the water produced was clear and free of fine sediments. An alternative method of swabbing and bailing was also used for monitor well 7 due to low yield and because it was screened just below the surface of the water table. All equipment was washed with a high pressure washer and steam cleaned between each site to avoid cross-contamination between wells.

Surveying

After completion of the monitor wells, the elevation of the top of the PVC casing of each well and the adjacent land surface were measured by a certified surveyor (Nichol Engineering Associates, Inc., Pensacola, Florida). The top of the PVC casing serves as a reference point from which all water levels are measured. Top of casing and land-surface elevations, referenced to mean sea level, are presented in Table 1.

Soil/Water Sampling and Analyses

One surface water, 16 ground-water, and 46 soil samples were collected at the site for chemical analyses. Soil samples were collected with a split-spoon sampler or, in the case of shallow samples, by a hand-operated auger sampler. Ground-water samples were collected from the monitor wells by first evacuating three to five volumes of standing water in the well using a submersible pump and then obtaining a sample using a bottom-entry Teflon bailer. Temperature, pH, and specific conductance of all water samples were measured at the time of collection. Sample handling, preservation, and chain-of-custody were carried out in strict compliance with the Quality Assurance Project Plan for Hydrogeologic Investigations at NAS Whiting Field, Florida, April 1986 (QA Plan). All chemical analyses were performed by an independent laboratory (Pioneer Laboratory, Inc., Pensacola, Florida) approved under the Navy's Quality Assurance (QA) Program for analytical work performed for NACIP.

HYDROLOGIC SETTING

Location

NAS Whiting Field is located in north-central Santa Rosa County, approximately seven miles north of the town of Milton and 20 miles northeast of Pensacola. The station is divided into two fields; the North Field is used for fixed-wing training and the South Field is used for helicopter training.

Climate

The climate of northwest Florida is generally humid, subtropical, with warm summers and mild winters. Temperatures average 81°F in the summer and 54°F during winter months. Rainfall is abundant, generally ranging from 53 to 67 inches per year. During the fall months, short-term dry spells are frequent.

The two dominant wet periods occur in late winter or early spring and during June through August. The period occurring during late winter-early spring is generally the result of thunderstorm activity caused by warm moist air moving in from the Gulf of Mexico (Wagner, et al., 1980).

Topography and Drainage

Whiting Field is located on an upland area with elevations as great as 190 ft msl (feet above mean sea level) and bounded on three sides by the erosion of the deep valleys of Clear Creek on the south and west and Big Coldwater Creek

on the east, both of which are tributary to Blackwater River to the south. Ancient marine terraces can be seen in the nearly level upland surface and on the valley slopes southeast of the base at elevations of 70 and 30 ft msl. Clear Creek and Big Coldwater Creek are classified by the FDER as Class III Surface Waters and the Blackwater River is classified as an Outstanding Florida Water. Outstanding waters are considered to be of exceptional recreational and ecological significance.

Because of the relatively steep valley walls and the ±100 ft drop in elevation between NAS Whiting Field and the receiving creeks, erosion became a serious problem when the land was disturbed for construction of the base. Soil conservation measures in the form of extensive contouring and construction of large paved ditches were instituted to control surface runoff from the upland area of the base. This system of ditches and storm sewers conveys surface-water runoff to Clear Creek and Big Coldwater Creek. These and other surface-water drainage features are shown in Figure 4.

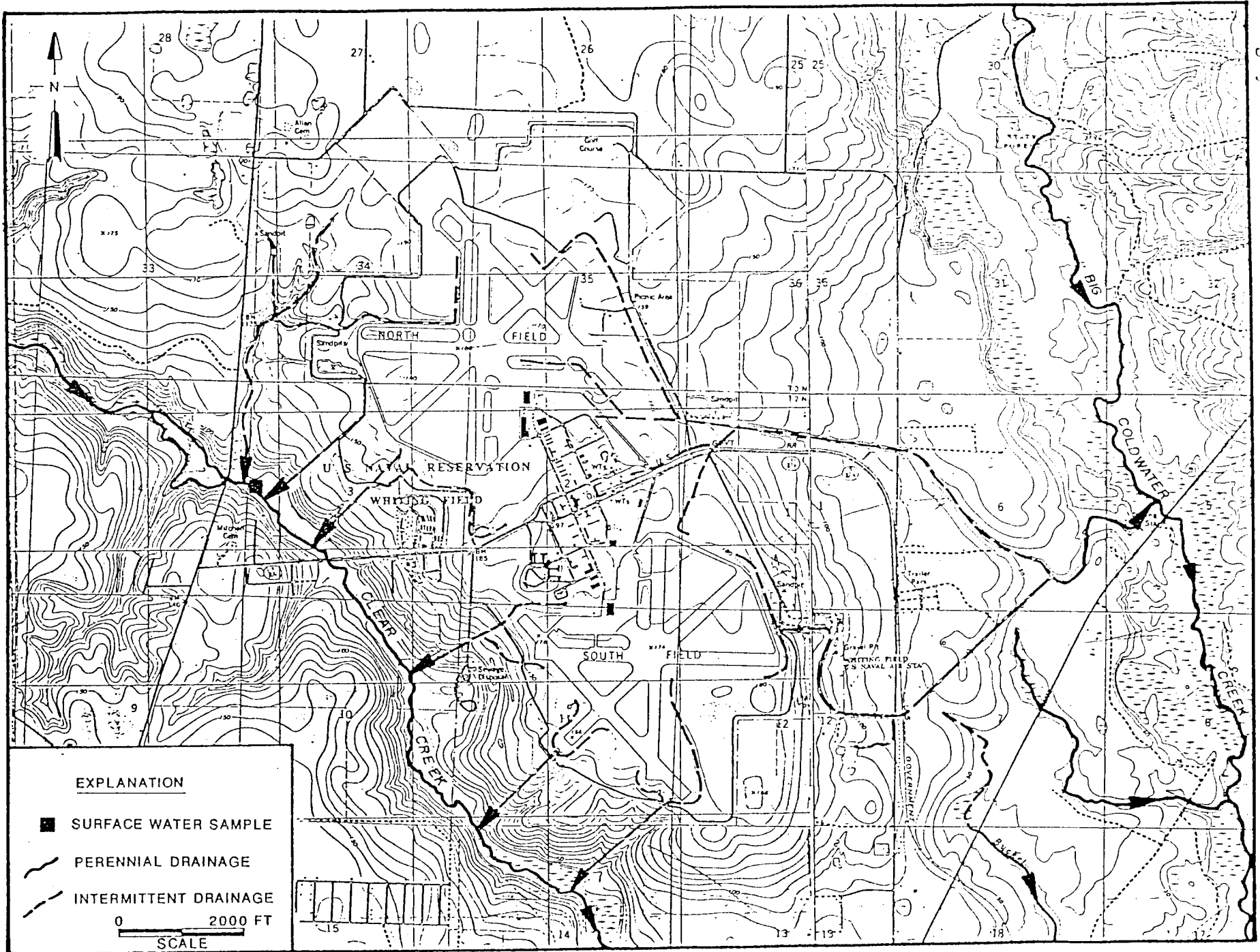


FIGURE 4. Locations of Surface Drainage Features.

GROUND-WATER SYSTEM

Geologic Framework of the Study Area

The geologic sequence of subsurface deposits and the corresponding hydrogeologic units underlying Whiting Field are illustrated in Figure 5, a composite geologic column constructed from published data and logs of wells in the area. Lithologic logs of borings and wells in the Whiting Field area and their locations are included in Appendix A.

The three major ground-water aquifers within the region are the surficial sand and gravel aquifer, the Upper Floridan limestone aquifer, and the lower Floridan limestone aquifer. The most important aquifer with respect to this investigation is the sand and gravel aquifer because it is the uppermost water-bearing zone and virtually all ground water in the county is pumped from it, including three water-supply wells at Whiting Field.

Sand and Gravel Aquifer

The uppermost sediments, extending to a depth of about 350 ft, comprise the sand and gravel aquifer which is subdivided into two units. The water-table or upper part of the sand and gravel aquifer does not constitute a source for large water supplies; however, its primary importance is to recharge the lower more productive zone of the aquifer.

According to an aquifer test in the Milton area, the clayey sand confining unit separating the upper and lower is very

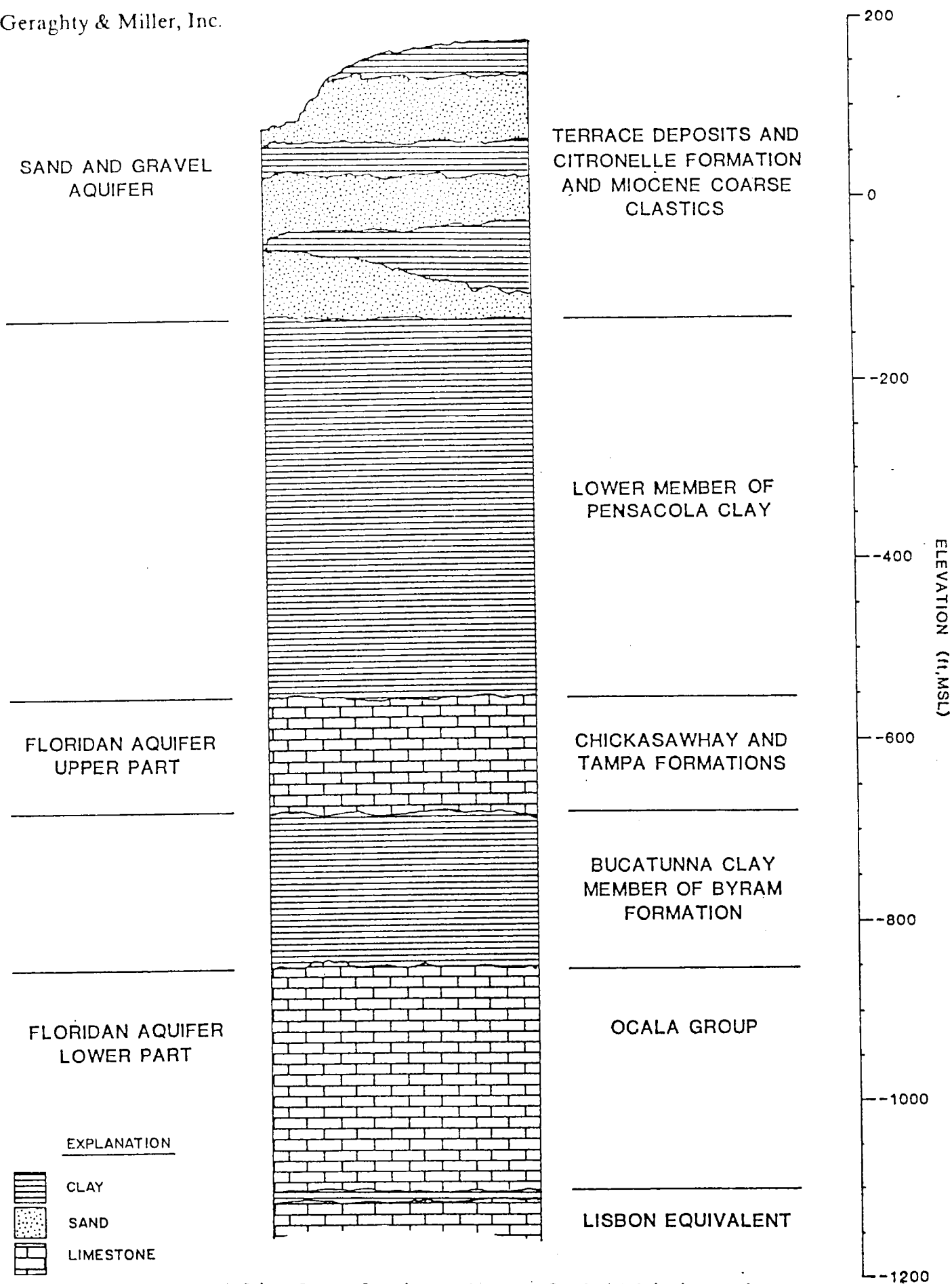


FIGURE 5. Generalized Geologic Column of the Whiting Field Area.

leaky. Most large capacity wells in the area, such as the NAS Whiting Field supply wells, are screened into the lower part of the aquifer from about 180 to 330 ft bls (feet below land surface).

The sand and gravel aquifer includes the upper Miocene coarse clastics, the Citronelle formation, and marine terrace deposits, three units which have similar hydraulic properties and sometimes are indistinguishable. The aquifer consists of poorly-sorted, fine to coarse sands with gravel and lenses of clay which may be as much as 60-ft thick. In some areas, the formation also contains wood fragments of all sizes, including whole tree trunks, occurring mostly in layers which may be as much as 25-ft thick (Marsh, 1966); however, logs of wells drilled on base do not indicate the presence of wood fragments.

The formation contains lensatic zones within the sand which are cemented by iron-oxide minerals. These lenses, known locally as "hardpan," have lower permeabilities and, along with the clay lenses, are responsible for the occurrence of perched water tables and semi-artesian conditions in the aquifer. In the Whiting Field area, clay lenses occur in the uppermost 30 ft and in the depth interval of approximately 110 to 170 ft (elevation 10-70 ft msl). Based on past drillers' log of the production wells, the vertical positions of these clay lenses in relation to the

screened intervals of the NAS supply wells are shown in Figure 6. Although the clays appear to be continuous, they may contain permeable zones or "windows."

The water from the sand and gravel aquifer is considered to be of excellent quality. Total dissolved solids and total hardness are generally less than 50 mg/l (milligrams per liter). However, because of high levels of dissolved carbon dioxide, the water is acidic with an ambient pH as low as 5.0 and locally contains high concentrations of iron.

Floridan Aquifer

Underlying the sediments of the sand and gravel aquifer is a thick (+300 ft), relatively impermeable Pensacola clay, below which are thick layers of limestone and shale to a depth of nearly 2,000 ft.

The limestone layers constitute the regionally extensive Floridan aquifer which, in this area, is divided into an upper and lower part separated by the Bucatana clay. The upper Floridan aquifer is an important source of water in areas east of Santa Rosa County; however, toward the west, it is increasingly mineralized and is generally not used as a water supply. The lower Floridan aquifer is highly mineralized in the Whiting Field area and is, in fact, designated for use as a waste-disposal injection zone. The Floridan aquifer receives little or no recharge from the sand

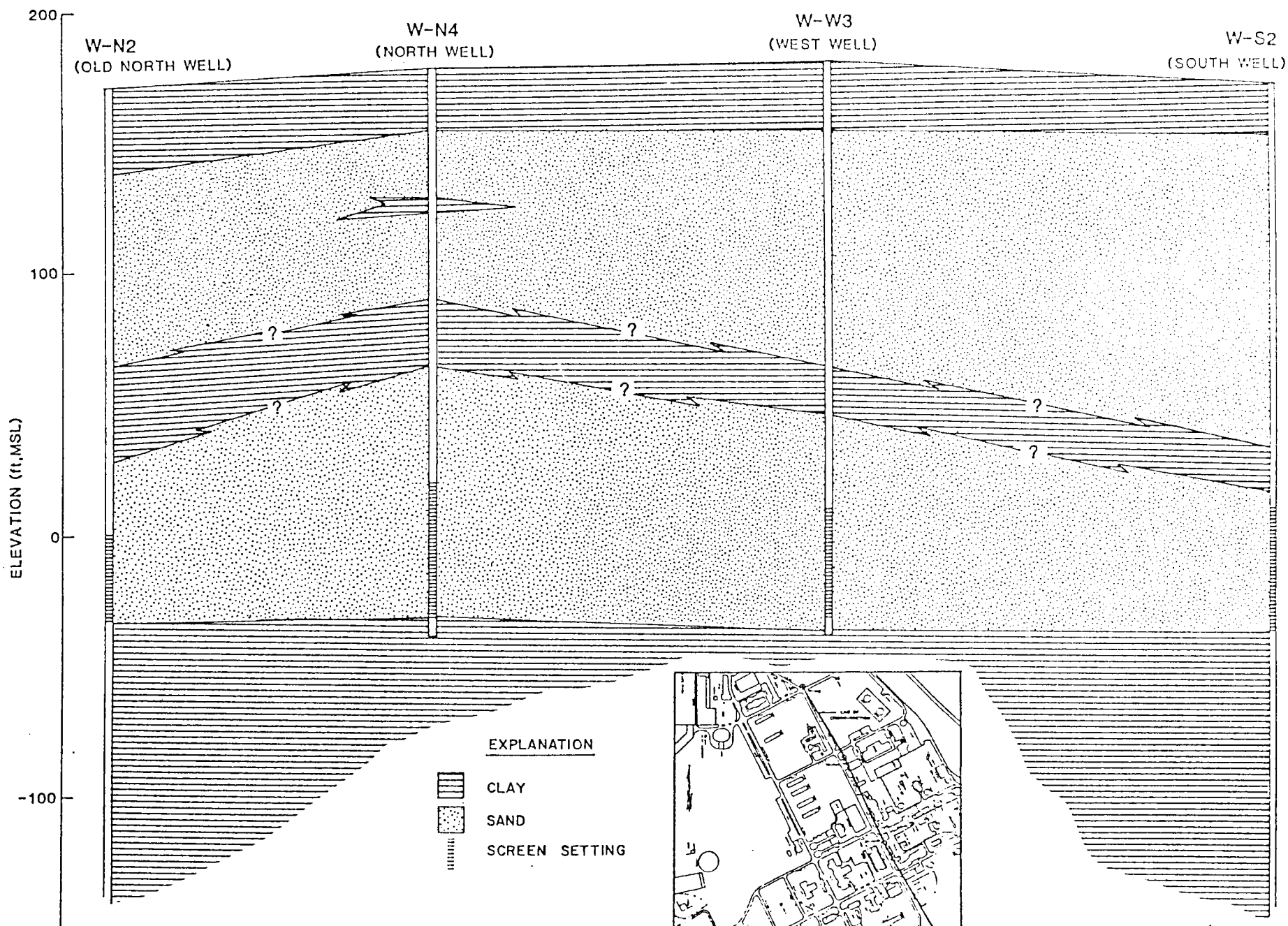


FIGURE 6. General Geologic Cross-Section of Sand and Gravel Aquifer at Whiting Field.

and gravel aquifer because of the Pensacola clay confining unit. The potentiometric surface of the Floridan aquifer in the NAS Whiting Field area is about 50-55 ft msl and the direction of flow is southeast.

Well Inventory

Essentially all potable and industrial water supplies in the Whiting Field vicinity are obtained from the sand and gravel aquifer, which extends from the surface to an approximate elevation of -150 ft msl (feet mean sea level). Screen settings are at depths of about 150 to 350 ft, depending on surface elevation and the occurrence of clay lenses which lie at somewhat erratic depths. An inventory of wells within one mile of the waste-disposal sites is presented in Table 2 and the locations of the wells are shown in Figure 7. The area includes most of Whiting Field and small residential neighborhoods south and east of the base.

Potable water on base is currently supplied by three wells: the north (W-N4), south (W-S3), and west (W-W3) wells; however, these are only the latest in a sequence of wells which have been replaced because of insufficient capacity or poor water quality. When the base was built in 1943, three wells were drilled: the original north (W-N1), south (W-S1), and west (W-W1) wells. In 1951 these wells were abandoned and replaced by new wells (W-N2, W-S2, and W-W2, respectively) within 75 ft of the original wells. The new wells were probably constructed to deliver increased yields.

Table 2. Inventory of Wells Within One Mile of Disposal Sites.

Well Designation	Owner	Date Installed	Casing Diameter (inches)	Surface Elevation (ft msl)	Total Depth (ft msl)	Screened Interval (ft msl)	Gravel Pack Interval (ft msl)	Status
W-N1	Navy	1943						Abandoned 1951
W-N2	Navy	1951	16	168.1	(-256.4)	(-1.4)- (-31.4)	60- (-31)	Not in use
W-N3	Navy	1975		171.5	(-58.5)	36.5- (-23.5)		Abandoned 1975
W-N4	Navy	1975	6/12	180.0	(-38)			In use
W-W1	Navy	1943						Abandoned 1951
W-W2	Navy	1951		197.6	(-157.4)	14.1- (-47.0)		Abandoned 1965
W-W3	Navy	1965		180.0	(-35.0)	10.0- (-30.0)	80- (-30)	In use
W-S1	Navy	1943						Abandoned 1951
W-S2	Navy	1951		181.5	(-159.5)	12.0- (-33.0)	17- (-33)*	In use
P-3	Point Baker Water System	1978		200**	(-20)**			In use
P-4	Point Baker Water System	1983						In use
USGS	U.S. Geological Survey	1974	6	125.0	(-1165)	Cased to (-860)		Monitor well

* Assumed

** Estimated

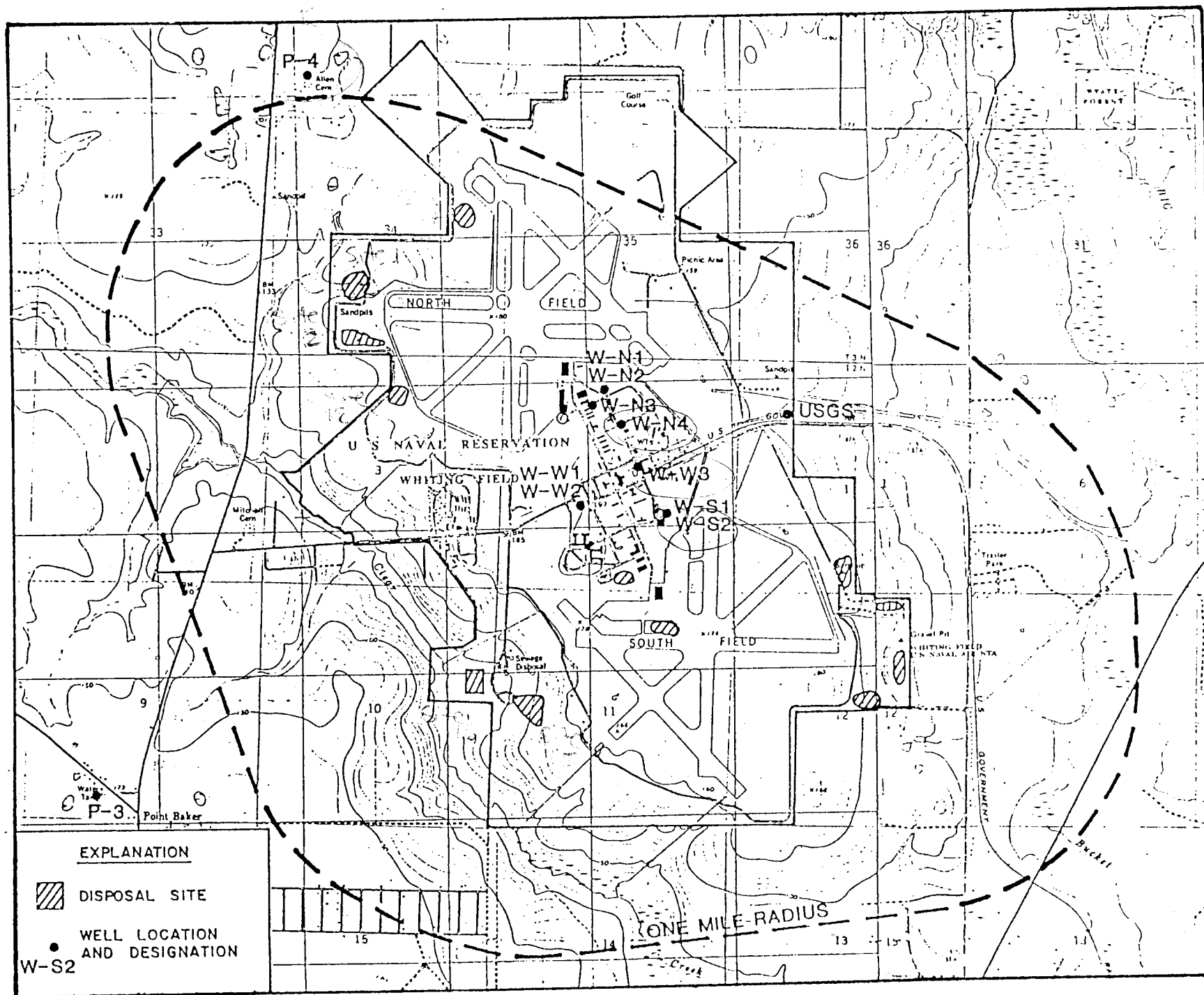


Figure 7. Locations of Wells Within One Mile of Disposal Sites.

The west and north wells, however, contained objectionable levels of iron and were replaced by W-W3 in 1965 and W-N3 in 1975, respectively. The replacement north well, which was drilled as a test well, was also found to have an unacceptable iron concentration and was subsequently abandoned and replaced by the currently used north well (W-N4). Locations of the active Navy wells are shown in Figure 8. Current average pump capacity from the wells at Whiting Field is: North well, 600 gpm (gallons per minute); West well, 700 gpm; and South well, 450 gpm. Flow from the three active supply wells is treated before entering the distribution system. Treatment consists of chlorination, pH adjustment, and addition of a sequestering agent to reduce iron precipitation.

Presently, only the north supply well W-N4 is pumping and supplying water to NAS Whiting Field. Per the FDER's request, supply well W-S2 was shut down on August 28, 1986, due to concentrations of benzene exceeding the state's drinking-water standard of 1 ug/l (micrograms per liter) in the ground water; subsequently, supply well W-W3 was also shut down on September 25, 1986, due to concentrations of trichloroethene greater than 3 ug/l in the water. Presented in Appendix D are the results of chemical analyses of the water from the three supply wells, conducted primarily in conjunction with the on-going Battery Shop investigation.

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Water for the City of Milton is supplied by five wells, for East Milton by two wells, and for the Point Baker-Allentown area by three wells, all of which are screened in the sand and gravel aquifer and all of which are outside of the one-mile radius; however, two of the Point Baker wells (P-3 and P-4) are close enough that they are included in the inventory. Average pumpage from these two wells is: P-3, about 500 gpm; and P-4, about 200 gpm. Water from the Point Baker system is available to residences west and north of Whiting Field, and water from the Milton system is available to those east and south of Whiting Field. It is believed that few if any private wells in these areas are still used.

SITE-SPECIFIC SUBSURFACE HYDROLOGY

Geology

Based on the lithologic logs of the monitor wells drilled during the field investigation (Appendix A), most of the NAS is capped by low-permeable sediments consisting of sandy clay or clay ranging in thickness from about 20 to 80 ft. The exception was found at Sites 1 and 18, located along the west side of the North Field, where these clayey sediments were absent at the surface. Generally, to the total depths of the wells drilled (42 to 180 ft), the lithology is described as fine to coarsed-grained sand with randomly interbedded lenses and layers of gravel and clay. Figure 9 illustrates a subsurface cross-sectional view across the NAS.

Ground-Water Movement

The sand and gravel aquifer is recharged by infiltration of rainwater at the surface. The downward movement of water through the unsaturated zone can be impeded by clay layers, where they exist, resulting in intermittent perched water tables. During the installation of the initial monitor well at Site 5, the presence of perched water tables was investigated. This was accomplished by setting the well screen at several different depth intervals as the borehole was advanced. No saturated zones within the upper 120 ft of sediment were found. Likewise, during the drilling

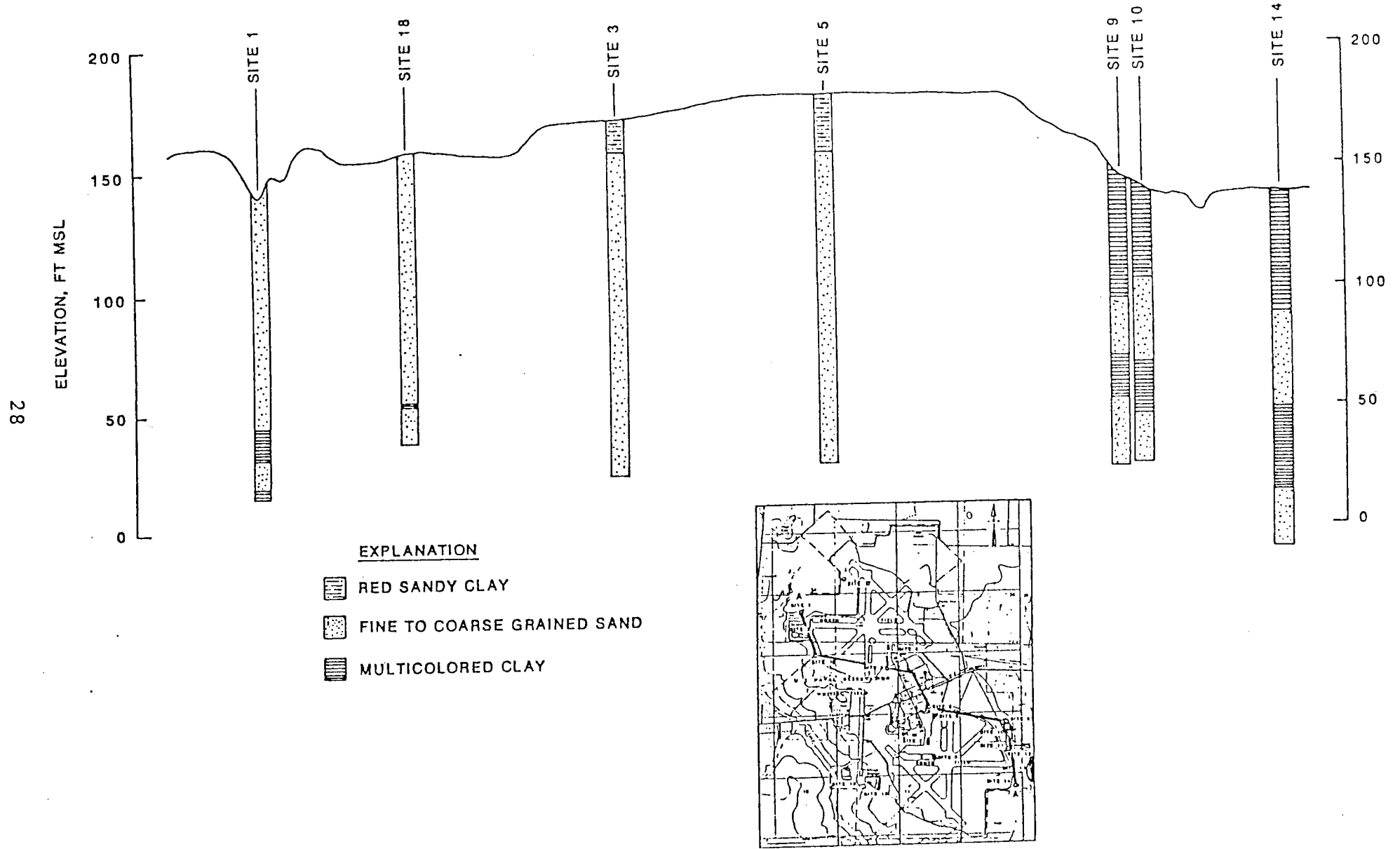


FIGURE 9. Geologic Cross-Section of Uppermost Sediments.

operations of all other wells installed at the site, there were no indications that water-yielding zones existed above the zones tapped by the monitor wells.

Water levels in the monitor wells installed in the upper part of the sand and gravel aquifer ranged from about 80 ft msl in the north to 45 ft msl in the south of the base, as shown by the water-table contour map presented in Figure 10. Water-level measurements in the monitor wells were made on October 17, 1986, when only the north supply well W-N4 had been pumping for several weeks. No obvious effects (drawdown) in the water levels of the upper sand and gravel aquifer are indicated by the water-table map, which is due in part to the steep hydraulic gradient at the site. Water levels ranged from 11 ft to 130 ft bls and generally are directly related to the topography; that is, the greatest depths to the water table occurred at the highest topographic locations and the shallowest depths to water occurred at the lowest topographic locations. The direction of ground-water flow across the site is generally southeast to south and southwest.

Water levels measured in supply wells W-S2 (62.51 ft msl) and W-W3 (64.42 ft msl) (tapping the lower sand and gravel aquifer) while they were shut down were compared to water levels in nearby monitor wells (tapping the upper sand and gravel aquifer) installed for this study. The comparison did not show a significant difference in head between the two

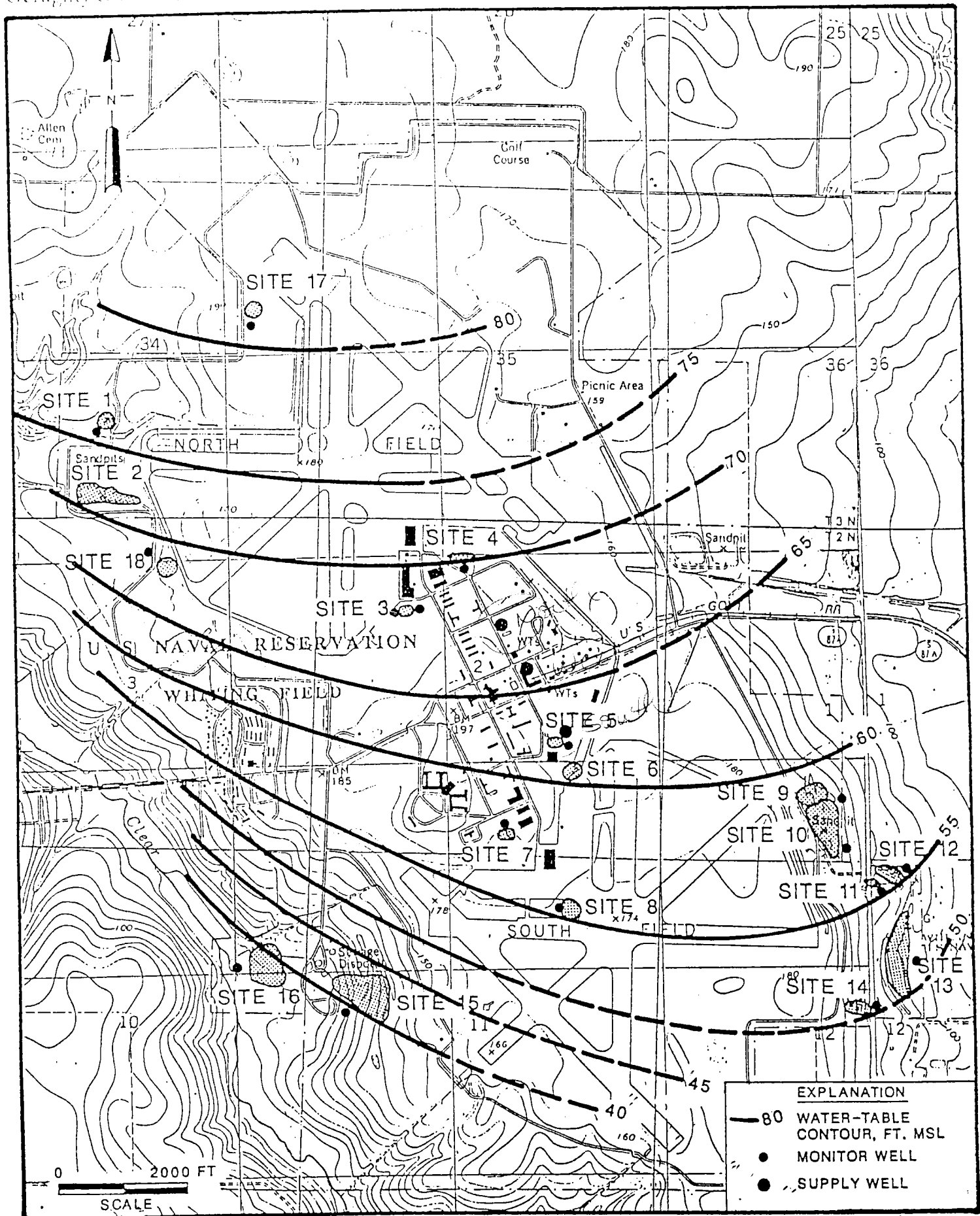


FIGURE 10. Water-Table Contours of Sand and Gravel Aquifer, October 17, 1986.

zones of the aquifer. This is best exemplified at Site 5 (Battery Shop site) where four upper sand and gravel wells (GMW-1 through GMW-4) are in close proximity to supply well W-S2. Differences in water levels between the two zones were no greater than a few tenths of a foot. A pumping test conducted at Site 5 (Battery Shop) suggested that the upper aquifer and the lower production zone of the aquifer are hydraulically connected, although flow between the two zones is impeded by clayey sediments.

Hydraulic Properties

Published information of the hydraulic properties of the sand and gravel aquifer is scarce. The following specific capacities were determined from test pumping of the NAS wells installed in 1951: W-N2 16.7 gpm/ft (gallons per minute per foot of drawdown), W-W2 23.0 gpm/ft, and W-S2 21.7 gpm/ft. From these values, an average minimum transmissivity for the lower zone of the sand and gravel aquifer is estimated to be about 37,000 gpd/ft (gallons per day per foot). This agrees rather well with a transmissivity of 54,600 gpd/ft determined from a pumping test at Milton (Wagner, et. al., 1980) and with the transmissivity estimated from well W-S2 during the Battery Shop study (30,000 gpd/ft).

Short-term specific capacity tests were run on all the monitor wells after development. Using an empirical relationship, the average minimum transmissivity of the upper

saturated part of the sand and gravel aquifer was estimated to be about 4,700 gpd/ft.

Water Quality

The chemical parameters analyzed from water samples collected at each site are described in the following section of the report entitled "Site Assessments." At most of the sites where a monitor well was installed, ground-water samples were collected and analyzed for EPA's list of priority pollutants, which includes 115 organic compounds (volatiles, acid and base/neutral extractables, and pesticides) and 13 metals in addition to cyanide and phenols.

Specific conductance and pH measurements of all water samples were also determined in the field and the values are listed in Appendix B. Measurements for pH were considered to be artificially high, ranging from 6.3 to 10.20. It is believed that the high pH of the water samples is due to cement used to construct the wells, and in time this will become less of an influence to the ground water near the monitor wells. Specific conductance values were generally low (less than 200 umhos/centimeter); higher values (315-650 umhos/centimeter) occurred at monitor wells 10, 12, and 13 located in the southwestern part of the base.

SITE ASSESSMENTS

Northwest Disposal Area (Site 1)

Background

Site 1 is located on the west side of the North Field. This five-acre site was used as a general refuse disposal area from 1943 until around 1965 (Figure 11). Wastes disposed of at this site included general refuse and possible unknown quantities of waste paints, paint thinners, solvents, waste oils, and hydraulic fluids. The site is a surface depression and most of the on-site rainfall infiltrates directly into the soil; however, any surface-water runoff that might occur would be along the southwestern edge and would be intercepted by a concrete drainage ditch (designated as E ditch) that runs near the southern boundary of the site and conveys surface water to Clear Creek.

Monitor well 1 was installed to a depth of 122 ft adjacent to and southwest of the site, as shown in Figure 11; depth to the ground-water surface was about 66 ft. A ground-water sample was collected from the monitor well and a surface-water sample was collected from Clear Creek, downstream of the site (Figure 4). Both samples were analyzed for EPA's list of priority pollutants, which includes VOCs (volatile organic compounds), acid and base/neutral extractable organic compounds, pesticides (including endrin,

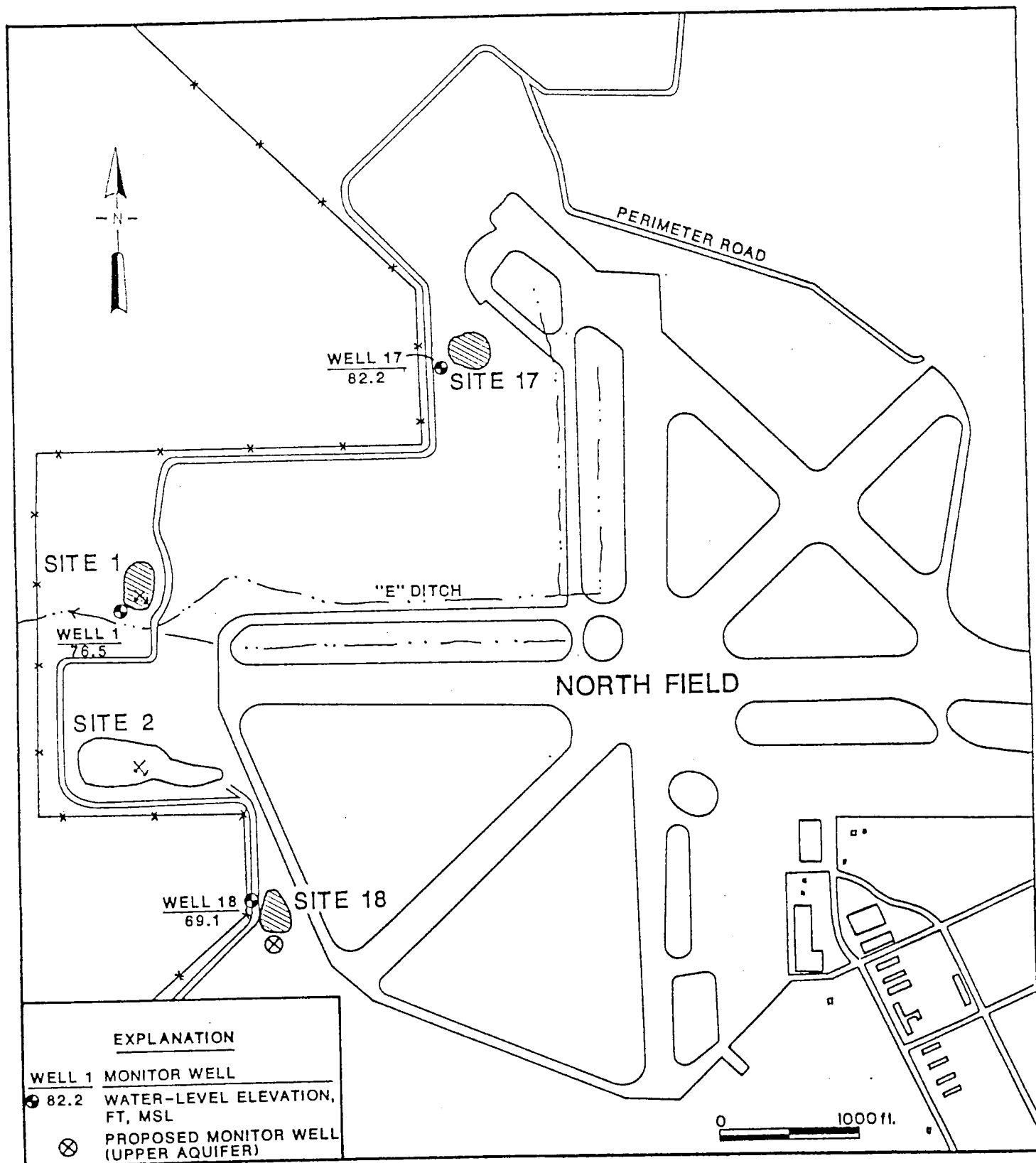


FIGURE 11. Location of Northwest Disposal Area (Site 1), and Crash Crew Training Areas (Sites 17 and 18).

lindane, kepone, toxaphene, chlorodane, malathion), herbicides, (2,4-D and 2,4,5-TP Silvex), PCBs (polychlorinated biphenyls), and metals.

Findings and Recommendations

The laboratory analyses of both water samples (Appendix C) did not detect any contaminants except for trace levels of lead, which are well below the State of Florida's primary drinking-water regulations (FAC 17-22.104). Based on these results, no adverse impacts to the water resources are judged to have occurred from this site. Even though no contaminants were detected at Site 1, it is recommended that a follow up water sample be collected from monitor well 1 and Clear Creek and analyzed for VOCs and metals. Upon confirmation of the original results, no further study of this site will be recommended.

Crash Crew Training Areas (Sites 17 and 18)

Background

During the last 25 years, two general areas near the west side of North Field have been used for fire-fighter training. Presently, Sites 17 and 18 (Figure 11) are being used; however, the specific training locations have periodically been relocated within the boundaries of the two sites. During a training session, approximately 110 gallons of JP-4 fuel is poured into shallow surface depressions, ignited, and then extinguished using an aqueous film-forming

foam (AFFF). According to the NAS records, 6,285 gallons of fuel and 3,148 gallons of AFFF were used during the last year (1984).

One monitor well tapping the uppermost part of the aquifer was installed adjacent to Site 17 (152 ft deep) and adjacent to Site 18 (122 ft deep) at the locations shown in Figure 11. The water-table surface was determined to be about 112 ft bls at Site 17 and about 94 ft bls at Site 18. Water samples collected from each well were analyzed for EPA's list of priority pollutants, including VOCs, acid and base/neutral extractable organic compounds, pesticides, PCBs, and metals.

Findings and Recommendations

Analyses of the ground-water samples from both sites (Appendix C) showed trace amounts of lead and mercury, which were below FDER's drinking-water standards. The only organic compound detected was bis (2-ethylhexyl) phthalate at 18 ug/l (Site 17) and 32 ug/l (Site 18). Upon investigating the composition of AFFF, it was learned that certain foams may contain minor amounts of particular phthlate esters (telephone communication with Mr. Tom Parker, Rockwood Systems Corporation, 10/14/86). Although drinking-water standards for phthalates have not been established, proposed EPA ambient water criterion for protection of human health has been calculated to be 15 mg/l or 15,000 ug/l (Sittig, 1985).

Based on the above, the presence of bis (2-ethylhexyl) phthalate does not appear to present an imminent hazard or risk to the environment at the two sites in question. However, it is suggested that another round of water samples from each well (17 and 18) be collected to confirm the low concentrations of the previous analyses and to verify the absence of fuel-based constituents. These samples will be analyzed for base-neutral extractable organic compounds and for benzene, toluene, and xylene according to EPA Method 625 and 602. Also, analyses will be performed for surfactants (as MBAS) and fluoride which can be common constituents of these types of fire-extinguishing agents.

In addition to the above, it is recommended that another monitor well be installed south of Site 18 and in a more downgradient direction into the upper part of the aquifer. Analysis of the ground water will be performed for the same constituents mentioned above.

Underground Waste Solvent Storage Area (Site 3)

Background

Site 3 is located on the southeastern side of the North Field (Figure 12). North supply well W-N4 is located about 1,400 ft southeast of the site. Two 500-gallon underground metal tanks were used from 1980 to 1984 for the storage of waste solvents and residue generated from paint-stripping operations. In April 1984, the two tanks were removed;

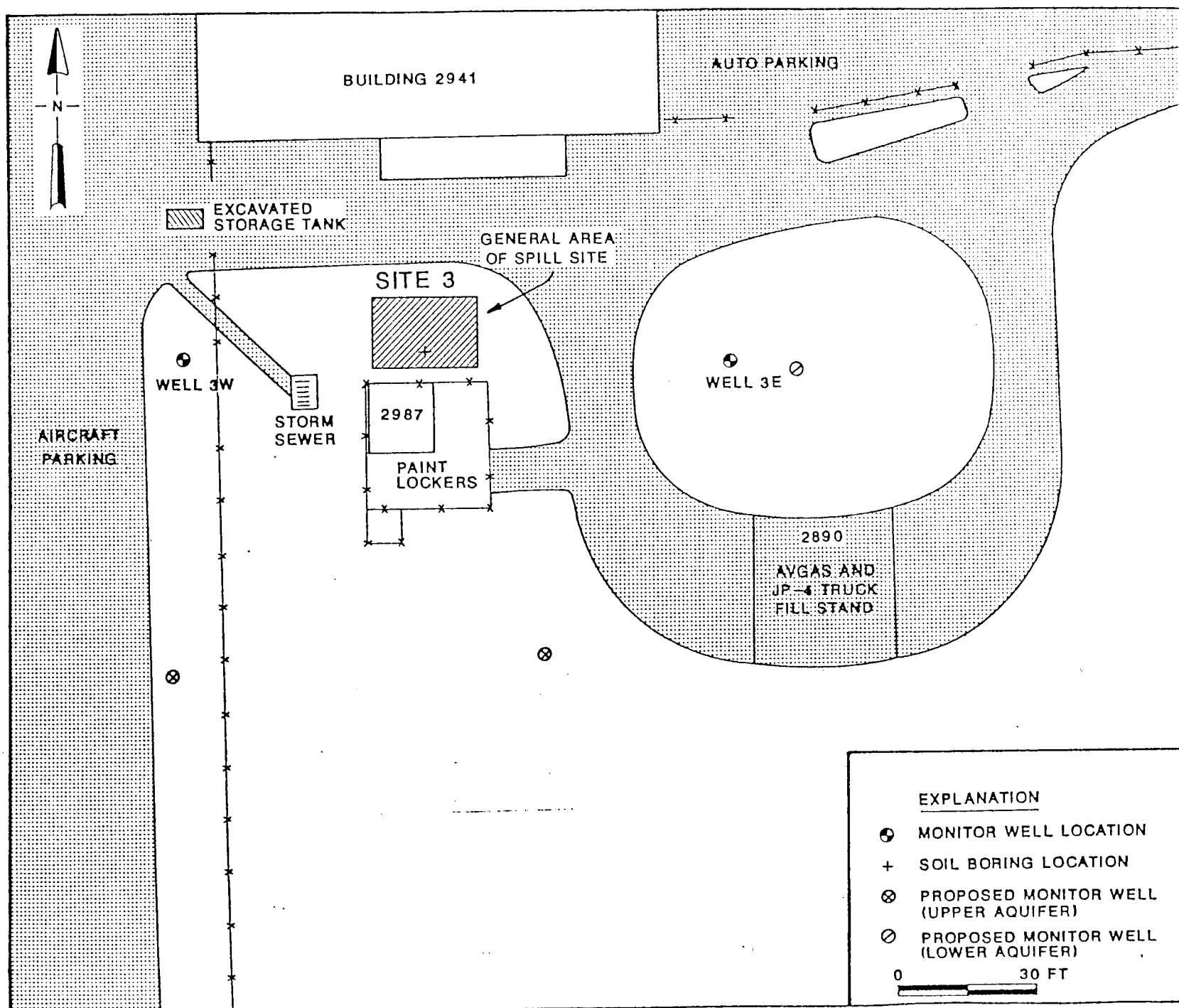


FIGURE 12. Site Plan of Underground Waste Solvent Storage Area.

however, during excavation, approximately 120 gallons of waste solvents accidentally spilled onto the ground. Clean-up operations conducted at the site resulted in the recovery of approximately 50 gallons of the waste solvent and approximately six cubic yards of contaminated soil were removed and disposed of off-site in an approved landfill. Subsequent examination of the tanks revealed two holes approximately 1/2-inch in diameter corroded through the tank walls. A partial chemical analysis of the waste contained in the tanks in 1981 is presented in Appendix C.

A soil boring was drilled at the spill site and split-spoon core samples were collected on 5-ft intervals to a total depth of 25 ft. Based on the samples collected, the soils to a depth of 20 ft consist primarily of red clay with minor amounts of sand (Appendix A). Within the interval of 20 to 25 ft, the lithology changed to a fine to medium-grained white sand.

Monitor wells 3E and 3W were installed about 50 ft east and 60 ft west of the site and tap the upper sand and gravel aquifer at a depth of 152 ft. The locations of the monitor wells and the soil boring are shown in Figure 12. Water levels in both wells are over 100 ft bls and their elevations essentially the same, only differing by a few hundredths of a foot.

Both the ground-water samples and the soil samples were analyzed for VOCs, benzene, toluene and xylene (BTX), methyl

isobutyl ketone (MIBK), phenols, and metals (including chromium, lead, cadmium, zinc, arsenic, barium, mercury, selenium, and silver). Analyses are presented in Appendix C.

Findings and Recommendations

No organic chemicals were detected in the soil samples to a depth of 25 ft except for phenols (0.61 ppm) at the surface, which probably is due to the vegetative matter in the uppermost part of the soil. Of nine metals analyzed for, five were detected in varying concentrations; Table 3 summarizes these results.

Table 3. Metals Analyses from Site 3 Soil Boring

Sample Depth (ft)	Concentrations, in mg/kg (ppm)				
	Zinc	Silver	Chromium	Cadmium	Mercury
0	586	0.92	43	0.28	0.20
5	2.6	1.85	29	<0.008	0.15
10	<0.8	1.74	24	<0.008	0.11
15	<0.8	0.98	7.1	<0.008	<0.01
20	<0.8	1.09	<1	<0.008	0.16
25	<0.8	0.75	<1	<0.008	0.22

The data show that zinc, chromium, and cadmium decreased to non-detectable levels with depth; silver and mercury were found in low concentrations to the depth of 25 ft. In general, all metals except mercury exhibited a decreasing trend of concentration with depth, indicating attenuation by the clayey soils.

Except for trace concentrations of arsenic and lead (below FDER's drinking-water standards), no metals were detected in the ground-water samples. However, to the west of the site in monitor well 3W, three chlorinated hydrocarbons were detected: 1,1,1-trichloroethane at 13 ug/l; 1,1,2-trichloroethane at 111 ug/l; and trichloroethylene at 18 ug/l. Based on the above-described findings, the ground water at Site 3 does not appear to be affected by metal contaminants. The ground water west of the "spill site," however, has been impacted by VOCs.

During the course of the field investigation, it was learned that a used oil storage tank located ± 30 ft north of monitor well 3W existed until January 1986 (Figure 12). At that time, the tank was excavated and removed to provide space for an extension of the adjacent pavement used for aircraft parking. Reportedly, this storage tank was used for waste oils, spent hydraulic fluids, and possibly some solvents. Considering this new information, it is uncertain whether the source of VOCs in well 3W is from the original spill site or the old underground tank located north of the well. It should be noted that there are no reports that any problems were experienced with this tank.

Nevertheless, it is recommended that additional monitor wells be installed to the south of Site 3, as shown in Figure 12, to help establish source, direction of movement, and areal extent of these VOCs in the ground-water system. Two

of the proposed wells will be installed in the upper part of the aquifer and are located based on general direction of ground-water flow in the upper part of the aquifer (i.e., downgradient and south from the sites) and the physical constraints posed by the site's location. It is recommended that a third well be installed adjacent to well 3E in order to determine whether VOCs have migrated into the lower part of the aquifer and might have moved east toward the supply wells. The existing and proposed monitor wells will all be sampled and analyzed for VOCs and PCBs (EPA Method 624 and 608); the water levels in all monitor wells also will be measured to establish a better definition of ground-water flow directions and hydraulic gradients. In addition, two continuous water-level recorders will be installed for one month in the deep monitor well and one of the upper aquifer monitor wells to determine drawdown effects of the hydraulic connection between the two zones while monitoring the discharge rate from the supply well W-N4. A third recorder will be installed in an upgradient well (such as monitor well 1) outside the potential cone of influence of pumping well W-N4 to compare baseline fluctuations in the water table.

North AVGAS Tank Sludge Disposal Area (Site 4)

Background

Site 4 is located southeast of the North Field. The north supply well is located approximately 1,100 ft southeast of the site. The site contains nine underground steel tanks,

of which eight were used in the past for aviation gasoline (AVGAS) storage. The tanks date back to 1943 when NAS Whiting Field first began operations. These eight tanks are labeled 1467, A, B, C, D, E, F, and G (Figure 13). The past use of the ninth tank, "H," is not known, but presently is used for contaminated jet fuel storage. Of the nine AVGAS storage tanks, six have been filled with water; the remaining three (F, G, and H) are still used for storage of gasoline, diesel, and contaminated jet fuel, respectively.

From 1943 to 1968, the nine AVGAS tanks were cleaned out approximately every four years. The tank bottom sludge, which contained tetraethyl lead, then was buried at shallow depths in the area immediately adjacent to the surrounding tanks. It has been grossly estimated that 1,000 to 2,000 gallons of sludge were disposed of in this manner.

Findings and Recommendations

Soil samples were collected from the uppermost sediments consisting of sandy clay to a depth of 2 ft at the locations shown in Figure 13. Portions of these samples then were mixed together to produce a composite sample. This sample was split into two parts and analyzed for total lead content and subjected to EP toxicity tests for lead. Analyses of the two soil samples determined total lead concentrations of 15 and 27 mg/kg. The results of EP toxicity tests were favorable with no detectable lead at 0.01 mg/l.

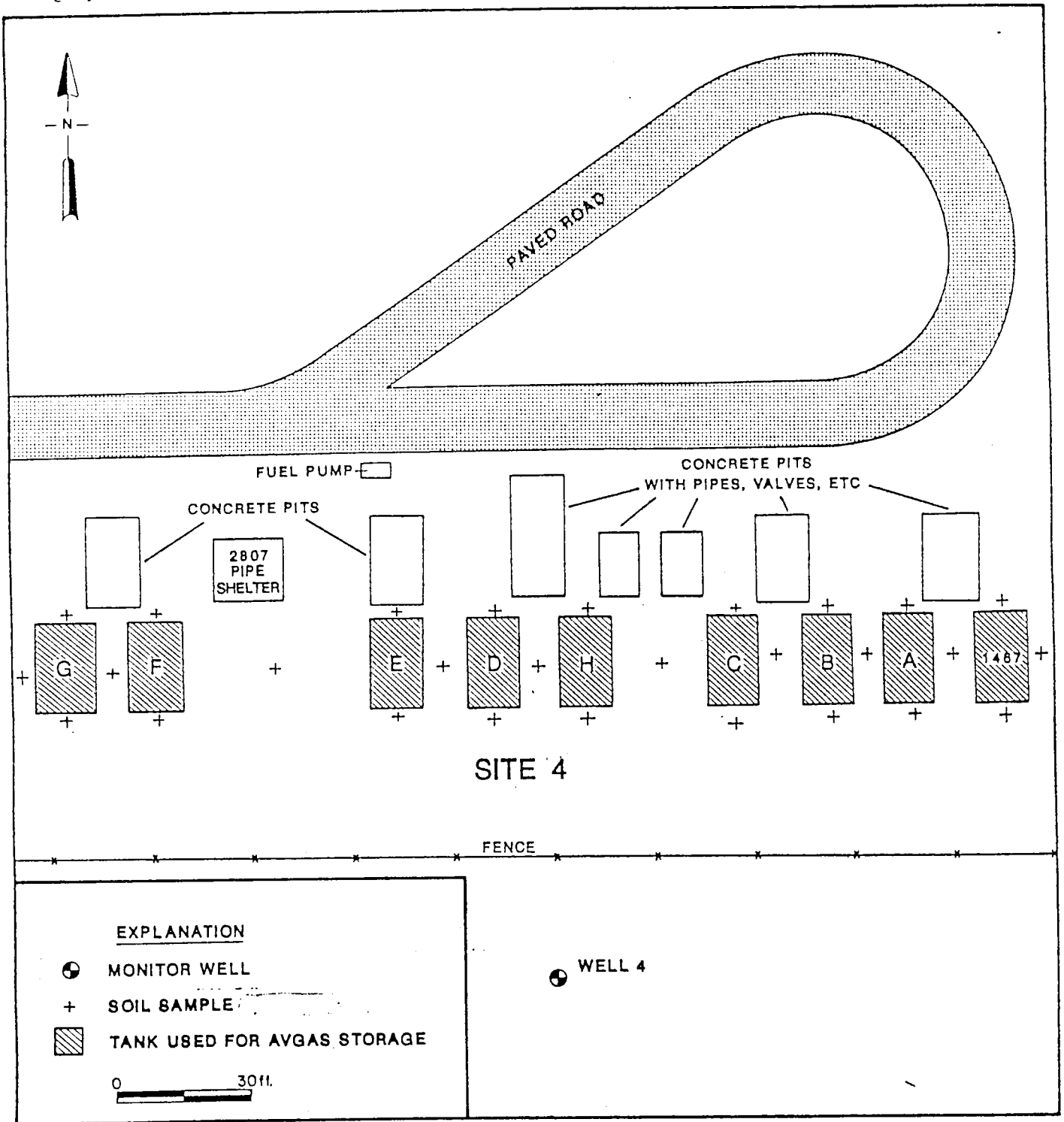


FIGURE 13. Location of North AVGAS Tank Sludge Disposal Area (Site 4).

A monitor well was also installed to a depth of 152 ft south of and adjacent to the site; depth to the ground-water surface was determined to be about 102 ft bls. The ground water was analyzed for the following constituents: BTX, naphthalene, EDB, and lead. The analyses (Appendix C) showed benzene at 17 ug/l and toluene at 10 ug/l in the water samples. A trace of lead, significantly below FDER's drinking-water standard, was also detected.

Hydrocarbons are present in the ground water at the site based on the analysis of monitor well 4; in particular, benzene exceeds the state's drinking-water standard of 1 ug/l (FAC 17-22. 104[1][g]). Because of its proximity to water-supply well W-N4, installation of additional monitor wells is recommended. To assist in determining the potential movement of contaminants from Site 4, it is recommended additional monitor wells be installed primarily south of the site and between the site and supply well W-N4. These new wells (Figure 14) will be drilled into both the upper zone of the sand and gravel aquifer and the production zone of the water-supply wells to a depth of ± 200 ft to determine if downward migration of contaminants has occurred and to determine the potential direction of lateral movement in the ground-water system. The ground water from both the existing and proposed monitor wells will be sampled and analyzed for dissolved aromatic hydrocarbons (EPA Method 602) and water levels will be measured to establish whether vertical head gradients exist between the two zones of the aquifer.

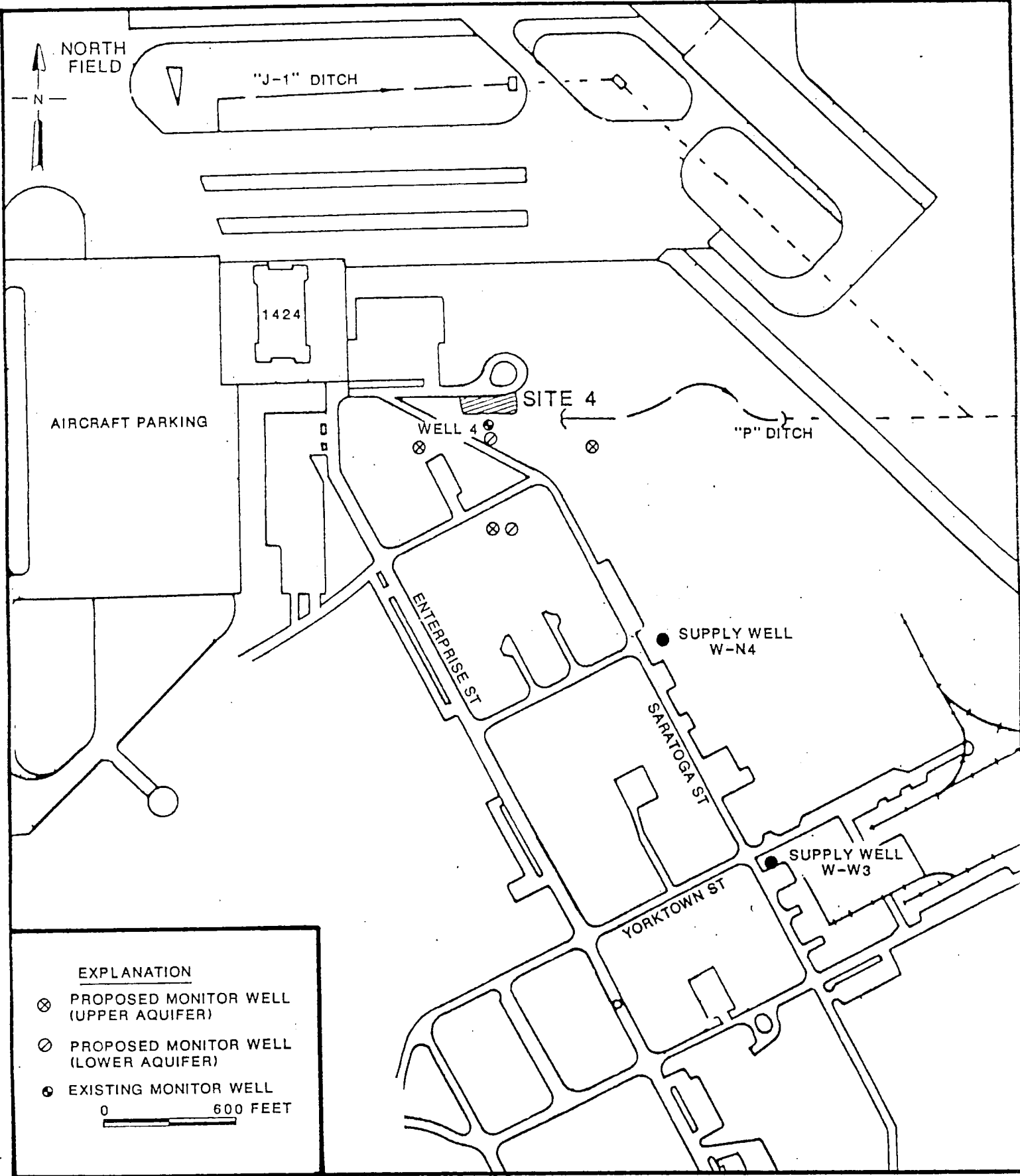


FIGURE 14. Locations of Proposed Monitor Wells for Site 4.

South Transformer Oil Disposal Area (Site 6)

Background

From the 1940's until 1964, dielectric fluid from transformers was reportedly drained into the grassed "0-2" ditch, which has since been paved. This fluid could have been contaminated with PCBs. The estimated area of disposal, shown in Figure 15, is located about 700 ft from supply well W-S2 and about 500 ft southeast of Building 1454. The "0-2" ditch drains in a northeasterly direction to the "0" ditch which connects to the "P" ditch and drains into Big Coldwater Creek. NAS Whiting Field's south supply well (W-S2) is located about 600 ft northwest of this old disposal area.

Findings and Recommendations

Ten soil samples were collected along the flanks of the paved ditch and analyzed for PCBs at the locations shown in Figure 15. The soils were described as typically sandy clay. Each sample was a composite sample from each location collected from the surface to a depth of 2 ft. The laboratory results (Appendix C) of the soil samples at Site 6 did not detect any PCBs above the detection limit of 0.2 mg/kg (milligrams per kilogram)(ppm).

The shallow soils in the area of suspected disposal of the oils do not show the presence of PCBs. In addition, previous analyses (EPA Method 608) of ground water from

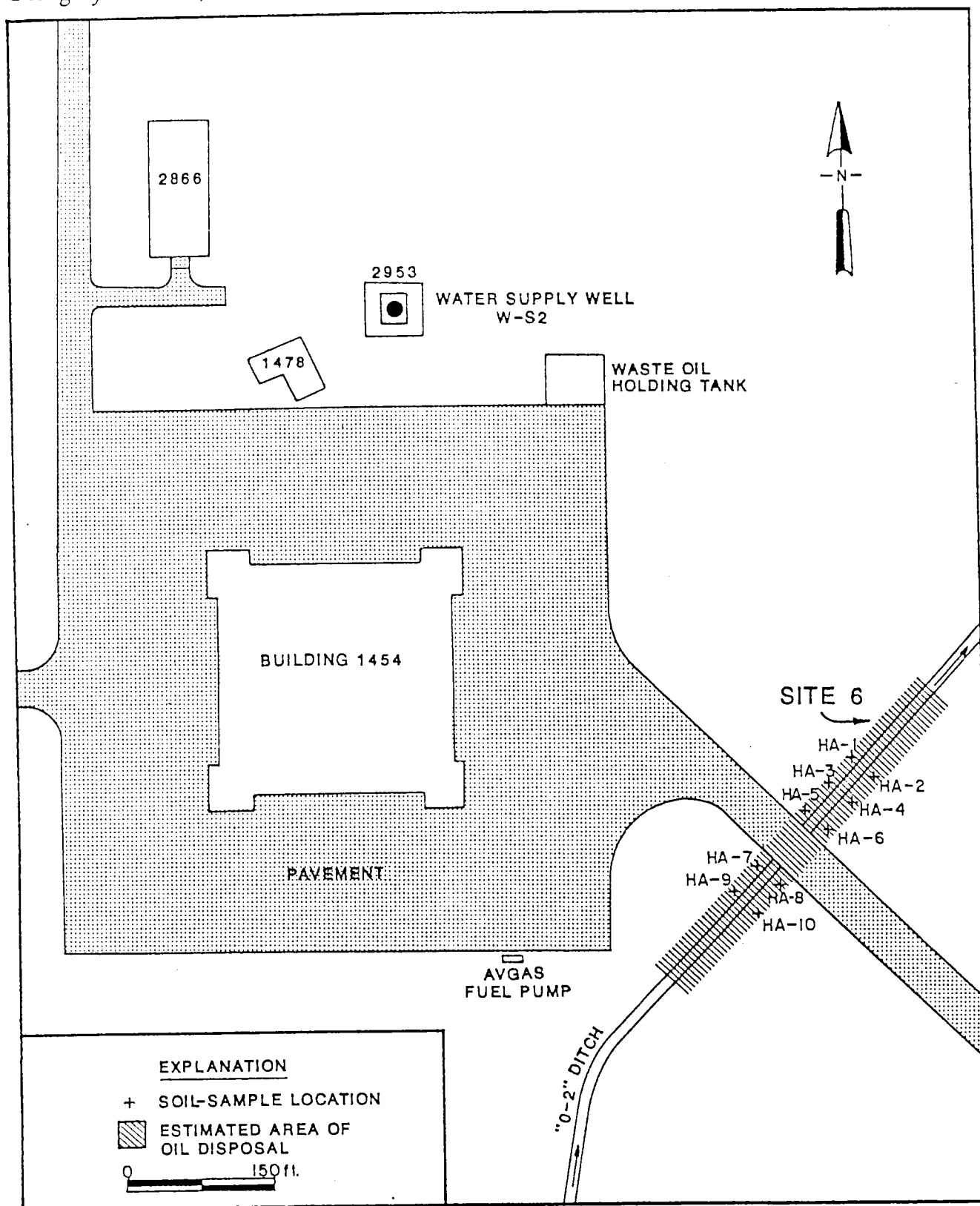


FIGURE 15. Location of South Transformer Disposal Area.

supply well W-S2 in November 1985, March 1986, and April 1986, did not detect any PCBs or other related compounds (see Appendix D). Based on this information, the site does not appear to be a threat to human health or the environment; therefore, no further study of this site is recommended.

South AVGAS Tank Sludge Disposal Area (Site 7)

Background

Site 7 is located northwest of the South Field and about 1,800 ft south of supply well W-S2 (Figure 16). It includes eight 23,700-gallon underground steel tanks and two 15,000 gallon lube oil storage tanks which were used for AVGAS and AVLUBE storage from 1943 to the late 1970's. Similar to Site 4, the tank bottom sludges, which contained tetraethyl lead, were buried at shallow depths in the area immediately surrounding the tanks. Roughly 1,000 to 2,000 gallons of sludge is believed to be buried throughout the tank farm. Presently, all but four of the tanks have been filled with water. These four active tanks are currently used for No. 2 fuel storage.

Findings and Recommendations

Soil samples of the uppermost sediments were collected to a depth of 2 ft at the locations shown in Figure 16. Portions of these samples were composited into two samples and analyzed for total lead content and EP toxicity for lead. A monitor well, also shown in Figure 16, was installed to a

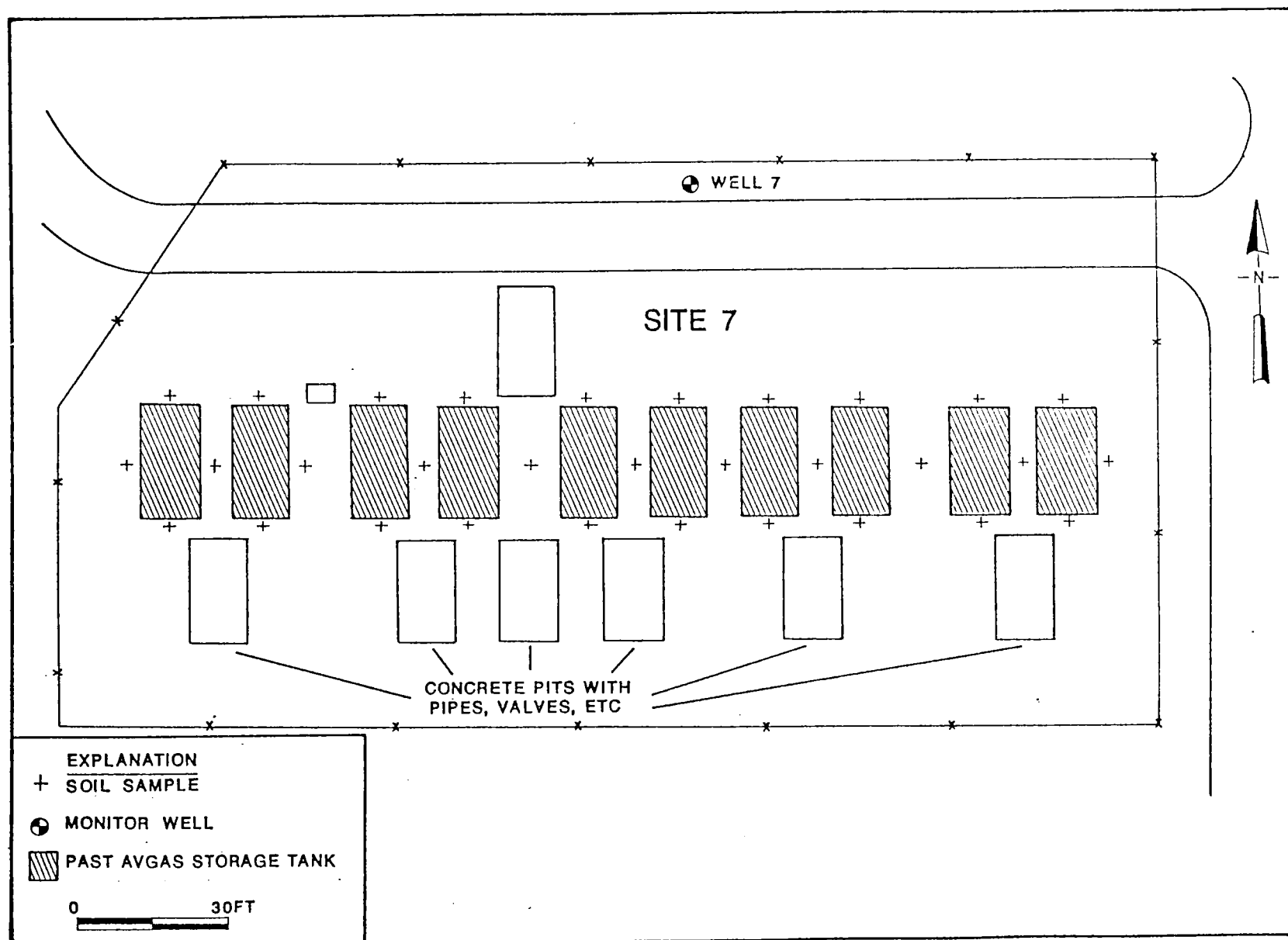


FIGURE 16. Location of South AVGAS Tank Sludge Disposal Area (Site 7).

depth of 142 ft into the upper sand and gravel aquifer; depth to the water-table surface was determined to be 130 ft bls. Ground-water samples were collected and analyzed for BTX, naphthalene, EDB, and lead.

The laboratory results of the soil samples (Appendix C) determined concentrations for total lead at 132 and 575 kg/mg; EP toxicity tests of these same soil samples did not detect any lead above the detection limit of 0.01 mg/l (Appendix C).

Analyses of the ground-water sample (Appendix C) collected from monitor well 7 determined high concentrations of benzene (8,800 ug/l), toluene (43,800 ug/l), EDB (23,560 ug/l), and also lead (0.86 mg/l). Benzene, EDB, and lead exceed the state's drinking-water standards.

Based on the chemical analyses, the ground water in the upper part of the sand and gravel aquifer near the south AVGAS tank farm has been impacted by lead and hydrocarbons. Two potential pathways of contaminant flow are considered: (1) to the south via the regional flow in the upper part of the sand and gravel aquifer, and (2) toward the north in the lower (and possibly the upper) part of the sand and gravel aquifer, under the influence of the pumping water-supply well W-S2.

In order to determine the possible direction of contaminant movement in the aquifer, four pairs of monitor

wells should be installed to different depths of +150 ft and +225 ft at the locations shown in Figure 17. This will allow the determination of contamination movement from Site 7 in both the upper and lower portions of the sand and gravel aquifer and assist in defining both the vertical and horizontal extent. Three pairs of wells should be installed south, southeast, and southwest of Site 7 in the direction of the regional flow of the ground water. Another pair of proposed wells will be installed mid-way north between Site 7 and supply well W-S2. These wells will determine if contaminants in the aquifer have moved northward under the influence of pumping well W-S2.

Monitor well 7 and the proposed monitor wells will be analyzed for aromatic hydrocarbons (BTX) and EDB according to EPA Methods 601 and 602; dissolved lead will also be analyzed for as an indicator of contaminant movement. Water levels will be measured in all these wells and in water-supply wells W-S2 and W-W3 to establish both horizontal and vertical ground-water gradients in the area.

AVGAS Fuel Spill Area (Site 8)

Background

Site 8 is located south of Building 1406 and adjacent to the helicopter training area at the South Field (Figure 18). High octane aviation fuel (25,000 gallons) was spilled at the South Field in the summer of 1972. The fuel flowed



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February 05, 1992

Commanding Officer
Naval Facilities Engineering Command
ATTN: Mr. Luis Vasquez, Code 18233
P.O. Box 10068
2155 Eagle Drive
Charleston, SC 29411-0068

Subject: Monitoring Well Cluster Installation Rationale
 North Fuel Farm
 South Fuel Farm
 NAS Whiting Field, Milton, Florida

Dear Luis:

During the undertaking of the Phase I field program at NAS Whiting Field it became readily apparent that the encountered contamination at the above subject sites was more pervasive in size and project scope than what had been originally understood at the onset of services. In addition, lithologic and hydrogeologic data gathered from soil borings advanced in the North and South Fuel Farm sites indicate the presence of a locally extensive clay lens at depths ranging from approximately 80 to 100-feet below land surface (bls). The net effect of a clay lens of this type is to act as an effective retardant for the downward migration of contaminants and surface waters, which percolate through the surficial soils directly above. At the North Fuel Farm site, groundwater levels were encountered in soil samples taken from both above and below the clay lens. Data obtained from recent groundwater investigations at the North Fuel Farm suggest that this lens may form a localized barrier between the perched groundwater above the clay lens and the regional, unconfined water table aquifer below the lens.

As stated above, it is suspected that the clay lens may inhibit vertical migration of contamination from the North Fuel Farm site into the regional aquifer, if the source of contamination is located directly above the clay lens. If the source of contamination is located above the upgradient edge of the clay lens, it is possible that the contamination will migrate below the lens into the unconfined water table aquifer.

As a means of assessing the net effect of the clay lens on the contaminant migration characteristics prior to the implementation of the Phase II well installation program it is ABB Environmental Services Inc.'s (ABB-ES) recommendation that three to five monitoring well clusters, consisting of one deep and one shallow well per cluster be installed at selected locations in the North and South Fuel Farm areas. The shallow wells will be screened in the perched water-bearing zone above the clay lens. The deep wells will be screened in the lower water-bearing zone 10 to 15-feet below the clay lens. The upper water-bearing zone will be sealed off

ABB Environmental Services Inc.

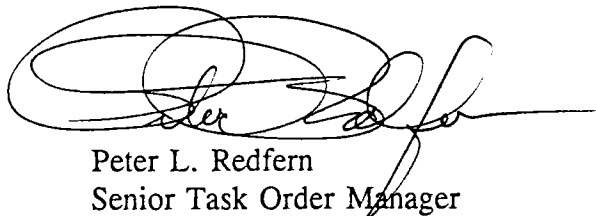
from the lower zone by surface casing installed approximately 2-feet into the top of the clay. All of the wells will be constructed of 4-inch ID PVC screen and riser pipe, with surface casing constructed of 8-inch ID PVC. All well materials for this preliminary investigation will adhere to the same construction and material specifications as those for the Phase II wells described in the Contamination Assessment Plan for NAS Whiting Field. Groundwater samples will be collected from all wells in accordance with ABB-ES's ComQAPP and analyzed for MTBE; Benzene, Toluene, Ethylbenzene, Xylenes (BTEX); TCE; and PCE. A 24-hour laboratory turnaround time will be requested for the results of the analyses.

In consideration of the magnitude of geologic field data which has been gathered during the Phase I program, the extent of contamination encountered, and the potential relationship of some contamination constituents encountered with other investigation programs presently in effect at NAS Whiting; it is ABB-ES's present intention to suspend all future Phase II field investigation activities effective on or about February 13, 1992. Subsequent to this date, ABB-ES will conduct an inhouse appraisal of field data gathered during its Phase I field investigation program, to more closely align monitoring well design and placement with exhibited field conditions. At this time, it would appear that recommencement of the Phase II field activities will be on or about February 24, 1992. Presently, it would not appear that this delay in the Phase II field investigation program will adversely affect the overall project schedule but rather allow for a more judicious design and placement of the monitoring wells, which should more accurately conform with prevailing site conditions.

To expedite the assessment program outlined herein, we would ask that you consider the above and let us know should you concur or not concur with the intentions as stated.

Should you have any questions concerning the above, please call.

Very truly yours,
ABB ENVIRONMENTAL SERVICES INC.



Peter L. Redfern
Senior Task Order Manager

cc: K. Busen
L. Huffman
J. Williams
file